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PATENT ABSTRACTS OF JAPAN

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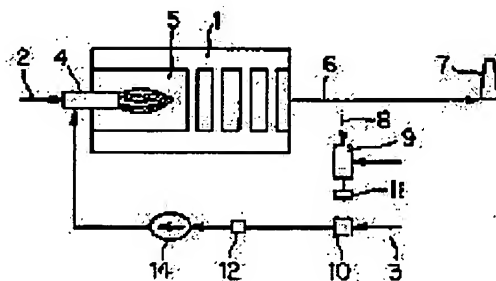
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KOBAYASHI HIROSHI
HIGUCHI NOBUO

(54) METHOD AND DEVICE FOR INJECTING WATER IN LOW NOX COMBUSTION DEVICE

(57)Abstract:

PURPOSE: To enable a desired low NoX formation of combustion gas to be attained by making a uniform mixing of injection water within combustion air under utilization of recirculated gas for recirculating discharged gas discharged from a combustion device.

CONSTITUTION: A method and an apparatus for injection water for restricting occurrence of NoX at a combustion device such as a boiler and the like are operated and constructed such that a circulating system for re-circulating discharged gas to the combustion device is provided with a water injecting part 9, water is injected into recirculating discharged gas and then a mixing part 10 is formed at a merging part with a combustion air supplying system 3 at a downstream side of the water injecting part 9. Then, the re-circulating discharged gas containing injection water and combustion air are forcedly and uniformly mixed at the mixing part 10.



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CLAIMS

[Claim(s)]

[Claim 1] In the water-injection method which supplies water in order to suppress generating of NOx in burners, such as a boiler Prepare the water-injection section in the circulation system which recycles exhaust gas to the aforementioned burner, make water inject in recycle exhaust gas, and the mixed section is formed in the unification section with the combustion-air supply system by the side of the slipstream of this water-injection section. The water-injection method in the low-NOx-combustion equipment characterized by mixing compulsorily uniformly the recycle exhaust gas which contains water jet in this mixed section, and a combustion air.

[Claim 2] the water-injection method in the low-NOx-combustion equipment according to claim 1 characterized by having prepared the detecting element of temperature and humidity in the slipstream side of the aforementioned mixed section, and suppressing dew condensation of water

[Claim 3] the water-injection method in the low-NOx-combustion equipment according to claim 1 characterized by having prepared the detecting element of temperature and humidity in the slipstream side of the aforementioned water-injection section, and suppressing dew condensation of water

[Claim 4] The water-injection method in the low-NOx-combustion equipment according to claim 1 characterized by making water inject in the water-injection section after preparing a recirculation-of-exhaust-gas fan in the circulation system which recycles the aforementioned exhaust gas and adjusting the amount of recycle and pressure of exhaust gas, forming the mixed section in the unification section with the combustion-air supply system by the side of an after that style, and mixing compulsorily uniformly the recycle exhaust gas which contains water jet in this mixed section, and a combustion air.

[Claim 5] the water-injection method in the low-NOx-combustion equipment according to claim 4 characterized by having prepared the detecting element of temperature and humidity in the slipstream side of the aforementioned mixed section, and suppressing dew condensation of water

[Claim 6] the water-injection method in the low-NOx-combustion equipment according to claim 4 characterized by having prepared the detecting element of temperature and humidity in the slipstream side of the aforementioned water-injection section, and suppressing dew condensation of water

[Claim 7] The water injector in the low-NOx-combustion equipment characterized by branching a recirculation-of-exhaust-gas duct from the exhaust gas duct of the aforementioned burner in the water injector which supplies water in order to suppress generating of NOx in burners, such as a boiler, arranging a water-injection machine into this recirculation-of-exhaust-gas duct, and making water inject in recycle exhaust gas.

[Claim 8] the water injector in the low-NOx-combustion equipment according to claim 7 characterized by having stationed the recirculation-of-exhaust-gas fan into the aforementioned recirculation-of-exhaust-gas duct, and forming the aforementioned water-injection machine in this recirculation-of-exhaust-gas fan's slipstream side

[Claim 9] the water injector in the low-NOx-combustion equipment according to claim 8 characterized by having arranged the sensor of temperature and humidity into the recirculation-of-exhaust-gas duct by the side of the slipstream of the aforementioned water-injection machine, and suppressing dew condensation of water

[Claim 10] the water injector in the low-NOx-combustion equipment according to claim 7 characterized by making a combustion-air supply pipe join the recirculation-of-exhaust-gas duct by the side of the slipstream of the aforementioned water-injection machine, arranging a mixer in this unification section, and mixing compulsorily uniformly the recycle exhaust gas which contains water jet with this mixer,

and a combustion air

[Claim 11] the water injector in the low-NO_x-combustion equipment according to claim 10 characterized by having arranged the sensor of temperature and humidity and suppressing dew condensation of water to the slipstream side of the aforementioned mixer

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Industrial Application] this invention relates to the water-injection method used in the reduction in NOx of burner use devices, such as a boiler, and its equipment.

[0002]

[Description of the Prior Art] The former, for example, a boiler, is widely used for the object for air conditioning air-conditioning, or business use from the object for power generation even to the large-sized shell minor type or the minimum capacity type not to mention industrial use. And those all came to receive regulation of pollution especially in the big city section, and especially the problem has been extracted to suppression of generating of NOx. Then, if a boiler explains the conventional low NOx-ization, it is based on the means as shown in drawing 3 and drawing 4. 21 [namely,] -- a boiler -- it is -- this boiler 21 -- fuel supply -- the fuel from a conduit 22, and air supply -- the air from a conduit 23 is supplied to a burner 24, it burns in a combustion chamber 25, and the boiler 21 is generating the steam by heating by the combustion in order [and] to lessen more NOx generated by the aforementioned combustion -- supply of water or a steam -- water or the steam was directly blown towards the flame 28 through the conduit 26 from the fuel injection equipment 27 (refer to drawing 3) In addition, 29 is a combustion-air forced draft fan.

[0003] moreover, the aforementioned air supply -- a conduit 23 -- on the way -- alike -- a fuel injection equipment 27 -- preparing -- supply of water or a steam -- the water or the steam from a conduit 26 was blown into the combustion air with the fuel injection equipment 27, humidification air was made, and this was supplied in the combustion chamber 25 (refer to drawing 4)

[0004]

[Problem(s) to be Solved by the Invention] By the way, in the case of drawing 3, the blown water or the steam causes incomplete combustion by flame cooling in a flame. Or if it serves as troubles, such as a thermal shock by the side of a boiler proper, in the heating surface of a boiler, and the amount of combustion moreover changes by the load effect, it blows in along with it and an amount changes Physical relationship of entrainments, such as a flame, and the heating surface, water, cannot be kept constant, but the direct entrainment of the water to a flame is lacking in practicality after all.

[0005] Moreover, since in the case of drawing 4 it is small compared with the amount of combustion and the amount of entrainments is difficult for adjustment of the amount It is difficult to carry out all the amounts of entrainments like a gas, and to convey it by the combustion air with ordinary temperature cold in practice, and the blown water or most steamy amount adheres to an intermediate duct etc., or it collects. adjustment of the amount which reaches the combustion flame section after all -- it cannot do -- therefore -- immediately -- adjustment of NOx -- not working -- further -- air supply -- a conduit -- when inside was covered with water, it became the cause of the rust of an inner damper and had become the cause of various claims, such as causing a poor operation Moreover, if the source of supply of the steam is needed and it asks a boiler etc. for this in the above conventional example in blowing a steam, become heat loss and it will become contrary to energy saving.

[0006] the place which this invention is made in view of such a trouble that a Prior art has, and is made into the purpose tends to offer the water-injection method that water jet is uniformly mixed in a combustion air, and low NOx-ization which is the request in combustion gas can be attained, and its equipment, using the recirculating gas which makes the exhaust gas from a burner recycle

[0007]

[Means for Solving the Problem] in order to attain the above-mentioned purpose, the water-injection

method in the low-NO_x-combustion equipment in this invention is characterized by to prepare the water-injection section in the circulation system which recycles exhaust gas to a burner, to make water inject in recycle exhaust gas, to form the mixed section in the unification section with the combustion-air supply system by the side of the slipstream of this water-injection section, and to mix compulsorily uniformly the recycle exhaust gas which contains water jet in this mixed section, and a combustion air [0008] Moreover, it is characterized by having prepared the detecting element of temperature and humidity in the slipstream side of the aforementioned mixed section, and suppressing dew condensation of water in a claim 2, and sets to a claim 3. It is characterized by having prepared the detecting element of temperature and humidity in the slipstream side of the aforementioned water-injection section, and suppressing dew condensation of water, and sets to a claim 4. After preparing a recirculation-of-exhaust-gas fan in the circulation system which recycles the aforementioned exhaust gas and adjusting the amount of recycle and pressure of exhaust gas, make water inject in the water-injection section, and the mixed section is formed in the unification section with the combustion-air supply system by the side of an after that style. It is characterized by mixing compulsorily uniformly the recycle exhaust gas which contains water jet in this mixed section, and a combustion air.

[0009] moreover, in a claim 5, it is characterized by having prepared the detecting element of temperature and humidity in the slipstream side of the aforementioned mixed section with the means according to claim 4, and suppressing dew condensation of water, and is characterized by having prepared the detecting element of temperature and humidity in the slipstream side of the aforementioned water-injection section with the means according to claim 4, and suppressing dew condensation of water in a claim 6

[0010] Furthermore, the water injector in the low-NO_x-combustion equipment in this invention is characterized by branching a recirculation-of-exhaust-gas duct from the exhaust gas duct of a burner, arranging a water-injection machine into this recirculation-of-exhaust-gas duct, and making water inject in recycle exhaust gas.

[0011] Moreover, in a claim 8, a recirculation-of-exhaust-gas fan is stationed into the aforementioned recirculation-of-exhaust-gas duct. It is characterized by forming the aforementioned water-injection machine in this recirculation-of-exhaust-gas fan's slipstream side, and sets to a claim 10. [0012] characterized by making a combustion-air supply pipe join the recirculation-of-exhaust-gas duct by the side of the slipstream of the aforementioned water-injection machine, arranging a mixer in this unification section, and mixing compulsorily uniformly the recycle exhaust gas which contains water jet with this mixer, and a combustion air

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TECHNICAL FIELD

[Industrial Application] this invention relates to the water-injection method used in the reduction in NO_x of burner use devices, such as a boiler, and its equipment.

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PRIOR ART

[Description of the Prior Art] The former, for example, a boiler, is widely used for the object for air conditioning air-conditioning, or business use from the object for power generation even to the large-sized shell minor type or the minimum capacity type not to mention industrial use. And those all came to receive regulation of pollution especially in the big city section, and especially the problem has been extracted to suppression of generating of NOx. Then, if a boiler explains the conventional low NOx-ization, it is based on the means as shown in drawing 3 and drawing 4 . 21 [namely,] -- a boiler -- it is -- this boiler 21 -- fuel supply -- the fuel from a conduit 22, and air supply -- the air from a conduit 23 is supplied to a burner 24, it burns in a combustion chamber 25, and the boiler 21 is generating the steam by heating by the combustion in order [and] to lessen more NOx generated by the aforementioned combustion -- supply of water or a steam -- water or the steam was directly blown towards the flame 28 through the conduit 26 from the fuel injection equipment 27 (refer to drawing 3) In addition, 29 is a combustion-air forced draft fan.

[0003] moreover, the aforementioned air supply -- a conduit 23 -- on the way -- alike -- a fuel injection equipment 27 -- preparing -- supply of water or a steam -- the water or the steam from a conduit 26 was blown into the combustion air with the fuel injection equipment 27, humidification air was made, and this was supplied in the combustion chamber 25 (refer to drawing 4)

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EFFECT OF THE INVENTION

[Effect of the Invention] Since the water-injection section is prepared in the circulation system which recycles exhaust gas to a burner and it was made to make water inject in recycle exhaust gas according to this invention Without making the steam for the reduction in NOx into a source of supply, water does not have un-arranging, such as an intermediate duct being covered with the blown water, or making the damage on incomplete combustion, a heat exchanger, etc. start from it being steam-ized and a combustion-air supply system being supplied uniformly compulsorily in a furnace, and, moreover, can suppress generating of NOx on real time. Moreover, if the injection quantity of the aforementioned water is adjusted corresponding to change of the load of a burner, since all this water will be used for suppression of generating of NOx, the adjustment will be exact and can be done easily.

[0023] moreover -- the case where the sensor which detects the temperature and humidity of gas to the slipstream [of the water-injection section] and slipstream side of the mixed section has been arranged From the moisture in the water by which the temperature and humidity of gas were continuously monitored by this sensor, the injection quantity and/or the recycle amount of exhaust gas of water were controlled corresponding to the amount of combustion airs, and injection was carried out [aforementioned] into the recirculation-of-exhaust-gas duct, or exhaust gas not dewing within a duct, especially When the temperature of combustion airs, such as a case where the temperature of the exhaust gas at the time of a low load is low in comparison, and winter, is low in comparison, while effective use of water is attained, damage on a device can also be prevented and suppression of easy, still more exact generating of NOx can be performed.

[0024] Moreover, exhaust gas. In making water inject in the water-injection section and mixing to a combustion air after that after preparing a recirculation-of-exhaust-gas fan in the circulation system to recycle and adjusting the amount of recycle and pressure of exhaust gas, even when this amount of exhaust gas is large, it also loses the problem that this fan's capacity must be enlarged beforehand, low [the temperature of exhaust gas] in the time of **** of during starting etc. so that the capacity of a forced draft fan may not become insufficient or a trip may not be carried out by the overcurrent.

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TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] By the way, in the case of drawing 3, the blown water or the steam causes incomplete combustion by flame cooling in a flame. Or if it serves as troubles, such as a thermal shock by the side of a boiler proper, in the heating surface of a boiler, and the amount of combustion moreover changes by the load effect, it blows in along with it and an amount changes Physical relationship of entrainments, such as a flame, and the heating surface, water, cannot be kept constant, but the direct entrainment of the water to a flame is lacking in practicality after all.

[0005] Moreover, since in the case of drawing 4 it is small compared with the amount of combustion and the amount of entrainments is difficult for adjustment of the amount It is difficult to carry out all the amounts of entrainments like a gas, and to convey it by the combustion air with ordinary temperature cold in practice, and the blown water or most steamy amount adheres to an intermediate duct etc., or it collects. adjustment of the amount which reaches the combustion flame section after all -- it cannot do -- therefore -- immediately -- adjustment of NOx -- not working -- further -- air supply -- a conduit -- when inside was covered with water, it became the cause of the rust of an inner damper and had become the cause of various claims, such as causing a poor operation Moreover, if the source of supply of the steam is needed and it asks a boiler etc. for this in the above conventional example in blowing a steam, become heat loss and it will become contrary to energy saving.

[0006] the place which this invention is made in view of such a trouble that a Prior art has, and is made into the purpose tends to offer the water-injection method that water jet is uniformly mixed in a combustion air, and low NOx-ization which is the request in combustion gas can be attained, and its equipment, using the recirculating gas which makes the exhaust gas from a burner recycle

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MEANS

[Means for Solving the Problem] in order to attain the above-mentioned purpose, the water-injection method in the low-NOx-combustion equipment in this invention is characterized by to prepare the water-injection section in the circulation system which recycles exhaust gas to a burner, to make water inject in recycle exhaust gas, to form the mixed section in the unification section with the combustion-air supply system by the side of the slipstream of this water-injection section, and to mix compulsorily uniformly the recycle exhaust gas which contains water jet in this mixed section, and a combustion air [0008] Moreover, it is characterized by having prepared the detecting element of temperature and humidity in the slipstream side of the aforementioned mixed section, and suppressing dew condensation of water in a claim 2, and sets to a claim 3. It is characterized by having prepared the detecting element of temperature and humidity in the slipstream side of the aforementioned water-injection section, and suppressing dew condensation of water, and sets to a claim 4. After preparing a recirculation-of-exhaust-gas fan in the circulation system which recycles the aforementioned exhaust gas and adjusting the amount of recycle and pressure of exhaust gas, make water inject in the water-injection section, and the mixed section is formed in the unification section with the combustion-air supply system by the side of an after that style. It is characterized by mixing compulsorily uniformly the recycle exhaust gas which contains water jet in this mixed section, and a combustion air.

[0009] moreover, in a claim 5, it is characterized by having prepared the detecting element of temperature and humidity in the slipstream side of the aforementioned mixed section with the means according to claim 4, and suppressing dew condensation of water, and is characterized by having prepared the detecting element of temperature and humidity in the slipstream side of the aforementioned water-injection section with the means according to claim 4, and suppressing dew condensation of water in a claim 6

[0010] Furthermore, the water injector in the low-NOx-combustion equipment in this invention is characterized by branching a recirculation-of-exhaust-gas duct from the exhaust gas duct of a burner, arranging a water-injection machine into this recirculation-of-exhaust-gas duct, and making water inject in recycle exhaust gas.

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OPERATION

[Function] With the water-injection method in the low-NO_x-combustion equipment in this invention constituted as mentioned above, and its equipment Since the temperature of the recirculating gas of the circulation system which recycles exhaust gas to a burner is usually the elevated temperature of 150 degrees C or more, when water is injected in this gas, it is necessary not to dare blow a steam from all this water serving as a steam, a combustion air and homogeneity being mixed, and combustion being presented, and suppressing generating of NO_x. And when the sensor has been arranged in the aforementioned circulation system, the temperature and humidity of gas are controlled by this sensor, and when the temperature of a recirculating gas or the temperature of a combustion air is low, it is made to correspond, and dew condensation of the water within a circulation system is suppressed. Moreover, it is made to correspond by the load for which the amount of recycle and pressure of exhaust gas are adjusted by this recirculation-of-exhaust-gas fan, and a burner is changed when the recirculation-of-exhaust-gas fan has been stationed.

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EXAMPLE

[Example] The example of this invention is explained with reference to drawing 1 and drawing 2. Drawing 1 shows an example which applied the water-injection method in the low-NOx-combustion equipment concerning this invention, and its equipment to the boiler, and drawing 2 shows other examples. and -- any case -- 1 -- a boiler -- it is -- this boiler 1 -- fuel supply -- the fuel from a conduit 2, and air supply -- the air from a conduit 3 is supplied to a burner 4, it burns in a combustion chamber 5, and the boiler 1 is generating the steam by heating by the combustion And the combustion gas which burned in the aforementioned combustion chamber 5 is emitted to the atmosphere through a chimney 7 from the exhaust gas duct 6.

[0015] In order not to include NOx if possible in the exhaust gas emitted from the aforementioned chimney 7, into the aforementioned exhaust gas duct 6, the recirculation-of-exhaust-gas duct 8 branches, and the other end of this recirculation-of-exhaust-gas duct 8 is connected to the burner 4. and the water-injection machine 9 arranges into this recirculation-of-exhaust-gas duct 8 -- having -- **** -- the slipstream side of this water-injection machine 9 -- the aforementioned combustion-air supply -- the mixer 10 is arranged at the unification section with a conduit 3

[0016] If the water of the specified quantity is injected from the water-injection machine 9 by the above composition in the recycle exhaust gas of the elevated temperature in the recirculation-of-exhaust-gas duct 8 The gaseous mixture of a combustion air is uniformly mixed with exhaust gas by the mixer 10 in the unification section with a conduit 3, and it is sent to a burner 4. the exhaust gas of an elevated temperature [water / this] -- all -- a steam -- becoming -- this steam -- the slipstream side of the water-injection machine 9 -- combustion-air supply -- this burner 4 -- setting -- fuel supply -- it is united with the fuel from a conduit 2, and burns in a combustion chamber 5 Since the steam of the specified quantity for suppressing generating of NOx is uniformly mixed into the combustion air in the case of this combustion, a combustion flame temperature is suitably lowered by this steam and the concentration of nitrogen or oxygen is also lowered relatively, generating of NOx can fully be suppressed. In addition, if the injection quantity of the aforementioned water is adjusted corresponding to change of the load of a burner, since all this water will be used for suppression of generating of NOx, the adjustment will be exact and can be done easily.

[0017] and when the sensor 11 and 12 grades which detect the temperature and humidity of gas to the slipstream [of the aforementioned water-injection machine 9] and slipstream side of a mixer 10 have been arranged, the moisture in the water by which the temperature and humidity of gas were continuously monitored by this sensor, the injection quantity and/or the recycle amount of exhaust gas of water were controlled corresponding to the amount of combustion airs, and injection was carried out [aforementioned] into the recirculation-of-exhaust-gas duct 8, or exhaust gas does not dew therefore, the temperature of the exhaust gas at the time of a low load -- comparatively -- alike -- a low case -- the sensor 11 by the side of the slipstream of the water-injection machine 9 -- moreover, the temperature of combustion airs, such as winter, is comparatively alike, and aforementioned dew condensation is suppressed by the sensor 12 by the side of the slipstream of a mixer 10 at a low case

[0018] In addition, although the amount of water which should be injected according to the grade which suppresses low NOx made into the purpose of this invention, i.e., NOx generated by combustion, and the amount of exhaust gas which should be recycled are decided, it is necessary to mix those amounts to a combustion air and to carry to a combustion chamber. If the amount and pressure of the recirculation of exhaust gas are insufficient, it will become impossible in this case, to inject and put in target water. Therefore, a recirculation-of-exhaust-gas fan may be needed.

[0019] And although it attaches in the recirculation-of-exhaust-gas duct 8 of drawing 1 when the

attaching position has neither the amount of this recirculation of exhaust gas, nor so large a pressure (illustration ****), and ** is also good, if those amounts and a pressure become large then and the air capacity etc. will not be specially controlled in the combustion-air forced draft fan 14 when the gas temperature of the recirculation of exhaust gas at the time of **** of during starting is especially low, required power may be improved and it may be unable to operate.

[0020] Then, as shown in drawing 2, the recirculation-of-exhaust-gas fan 13 is formed in the recirculation-of-exhaust-gas duct 8 which recycles exhaust gas, and if it is made to make water inject with the aforementioned water-injection vessel 9 after adjusting the amount of recycle and pressure of exhaust gas, above un-arranging will be lost.

[0021] And arrangement of the aforementioned sensor 11 and 12 grades and the recirculation-of-exhaust-gas fan's 13 arrangement are selected if needed, and can do various combination
*****.

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] Drawing 1 is the flow chart of one example suitable for carrying out the water-injection method in the low-NO_x-combustion equipment concerning this invention, and its equipment.

[Drawing 2] Drawing 2 is the flow chart of other examples.

[Drawing 3] Drawing 3 is the flow chart of the conventional example.

[Drawing 4] Drawing 4 is the flow chart of other conventional examples.

[Description of Notations]

1 Boiler

3 Air Supply -- Conduit

5 Combustion Chamber

6 Exhaust Gas Duct

8 Recirculation-of-Exhaust-Gas Duct

9 Water-Injection Machine

10 Mixer

11 12 Sensor

13 Recirculation-of-Exhaust-Gas Fan

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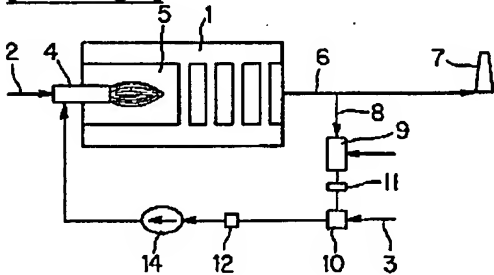
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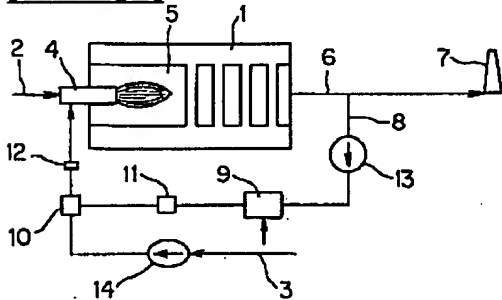
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DRAWINGS

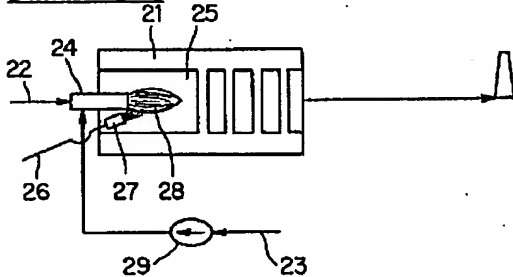
[Drawing 1]



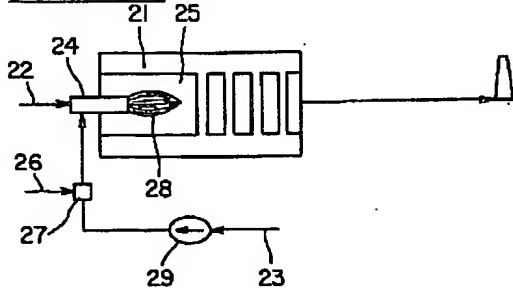
[Drawing 2]



[Drawing 3]



[Drawing 4]



(19)



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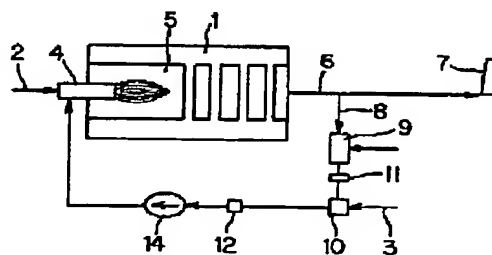
(54) METHOD AND DEVICE FOR INJECTING WATER
IN LOW NOX COMBUSTION DEVICE

(57) Abstract:

PURPOSE: To enable a desired low NoX formation of combustion gas to be attained by making a uniform mixing of injection water within combustion air under utilization of recirculated gas for recirculating discharged gas discharged from a combustion device.

CONSTITUTION: A method and an apparatus for injection water for restricting occurrence of NoX at a combustion device such as a boiler and the like are operated and constructed such that a circulating system for re-circulating discharged gas to the combustion device is provided with a water injecting part 9, water is injected into recirculating discharged gas and then a mixing part 10 is formed at a merging part with a combustion air supplying system 3 at a downstream side of the water injecting part 9. Then, the re-circulating discharged gas containing injection water and combustion air are forcedly and uniformly mixed at the mixing part 10.

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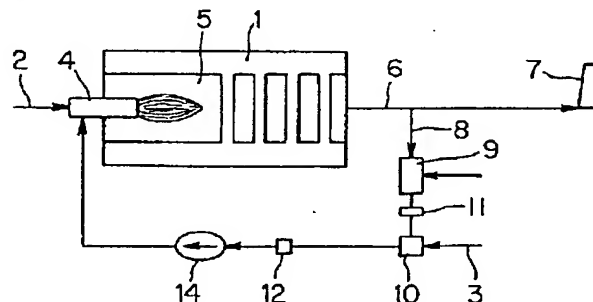
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(54) 【発明の名称】 低NO_x燃焼装置における水噴射の方法と装置

(57) 【要約】

【目的】 燃焼装置からの排ガスを再循環させる再循環ガスを利用して、噴射水が燃焼用空气中に均一に混合されて燃焼ガス中の所望の低NO_x化が図れるような水噴射方法およびその装置を提供する。

【構成】 ボイラ等の燃焼装置でのNO_xの発生を抑制するために水を供給する水噴射方法およびその装置において、前記燃焼装置へ排ガスを再循環させる循環系統8に水噴射部9が設けられて再循環排ガス中に水が噴射され、該水噴射部の後流側の燃焼用空気供給系3との合流部に混合部10が形成され、該混合部で噴射水を含む再循環排ガスと燃焼用空気とが強制的に均一に混合されるようにした低NO_x燃焼装置における水噴射方法およびその装置。



【特許請求の範囲】

【請求項 1】 ボイラ等の燃焼装置での NO_x の発生を抑制するために水を供給する水噴射方法において、前記燃焼装置へ排ガスを再循環する循環系統に水噴射部を設けて再循環排ガス中に水を噴射させ、該水噴射部の後流側の燃焼用空気供給系との合流部に混合部を形成して、該混合部で噴射水を含む再循環排ガスと燃焼用空気とを強制的に均一に混合することを特徴とする低 NO_x 燃焼装置における水噴射方法。

【請求項 2】 前記混合部の後流側に温度と湿度の検出部を設けて水の結露を抑制したことを特徴とする請求項 1 記載の低 NO_x 燃焼装置における水噴射方法。

【請求項 3】 前記水噴射部の後流側に温度と湿度の検出部を設けて水の結露を抑制したことを特徴とする請求項 1 記載の低 NO_x 燃焼装置における水噴射方法。

【請求項 4】 前記排ガスを再循環する循環系統に排ガス再循環ファンを設けて排ガスの再循環量および圧力を調整した後で水噴射部で水を噴射させ、その後流側の燃焼用空気供給系との合流部に混合部を形成して、該混合部で噴射水を含む再循環排ガスと燃焼用空気とを強制的に均一に混合することを特徴とする請求項 1 記載の低 NO_x 燃焼装置における水噴射方法。

【請求項 5】 前記混合部の後流側に温度と湿度の検出部を設けて水の結露を抑制したことを特徴とする請求項 4 記載の低 NO_x 燃焼装置における水噴射方法。

【請求項 6】 前記水噴射部の後流側に温度と湿度の検出部を設けて水の結露を抑制したことを特徴とする請求項 4 記載の低 NO_x 燃焼装置における水噴射方法。

【請求項 7】 ボイラ等の燃焼装置での NO_x の発生を抑制するために水を供給する水噴射装置において、前記燃焼装置の排ガスダクトから排ガス再循環ダクトを分岐し、該排ガス再循環ダクトに水噴射器を配置して再循環排ガス中に水を噴射させることを特徴とする低 NO_x 燃焼装置における水噴射装置。

【請求項 8】 前記排ガス再循環ダクトに排ガス再循環ファンを配置し、該排ガス再循環ファンの後流側に前記水噴射器を設けたことを特徴とする請求項 7 記載の低 NO_x 燃焼装置における水噴射装置。

【請求項 9】 前記水噴射器の後流側の排ガス再循環ダクトに温度と湿度のセンサーを配置して水の結露を抑制したことを特徴とする請求項 8 記載の低 NO_x 燃焼装置における水噴射装置。

【請求項 10】 前記水噴射器の後流側の排ガス再循環ダクトに燃焼用空気供給管を合流させ、該合流部に混合器を配置して、該混合器で噴射水を含む再循環排ガスと燃焼用空気とを強制的に均一に混合することを特徴とする請求項 7 記載の低 NO_x 燃焼装置における水噴射装置。

【請求項 11】 前記混合器の後流側に温度と湿度のセンサーを配置して水の結露を抑制したことを特徴とする

請求項 10 記載の低 NO_x 燃焼装置における水噴射装置。

【発明の詳細な説明】

【0001】

【産業上の利用分野】本発明は、ボイラ等の燃焼装置利用機器の低 NO_x 化において利用される水噴射方法およびその装置に関するものである。

【0002】

【従来の技術】従来、例えばボイラは発電用から産業用は勿論のこと、冷暖房空調用や業務用に大型から中小型あるいは極小容量型まで広く利用されている。そして、それらの全てが特に大都市部において公害の規制を受けるようになり、特にその問題は NO_x の発生抑制に絞られてきた。そこで、従来の低 NO_x 化をボイラで説明すると、図 3、図 4 に示すような手段によっている。即ち、21 はボイラであり、該ボイラ 21 は燃料供給導管 22 からの燃料と空気供給導管 23 からの空気がバーナ 24 に供給されて燃焼室 25 内で燃焼され、その燃焼による加熱によってボイラ 21 は蒸気を発生させている。そして、前記燃焼によって発生する NO_x をより少なくするため、水又は蒸気の供給導管 26 を介して噴射装置 27 から直接に火炎 28 に向け水又は蒸気を吹き込んでいた（図 3 参照）。なお、29 は燃焼用空気押し込みファンである。

【0003】また、前記空気供給導管 23 の途中で噴射装置 27 を設け、水又は蒸気の供給導管 26 からの水又は蒸気を噴射装置 27 によって燃焼用空気に吹き込んで加湿空気を作りこれを燃焼室 25 内に供給していた（図 4 参照）。

【0004】

【発明が解決しようとする課題】ところで、図 3 の場合、吹き込まれた水又は蒸気が火炎に当たると火炎冷却によって不完全燃焼をおこし、あるいはそれがボイラの伝熱面に当たるとボイラ本体側の熱衝撃などのトラブルとなり、しかも、負荷変動で燃焼量が変わりそれにつれて吹き込み量が変わると、火炎や伝熱面と水などの吹き込みの位置関係を一定に保つことができず、結局火炎への水の直接吹き込みは実用性に乏しいものである。

【0005】また、図 4 の場合、その吹き込み量が燃焼量に比べて僅かであるためにその量の調整が難しいこともあって、実際上常温の冷たい燃焼用空気によってその吹き込み量の全てを気体のようにして搬送することは難しく、吹き込んだ水又は蒸気のかかなりの量が途中のダクトなどにくっつき、あるいは溜ったりして、結局燃焼火炎部に到達する量の調整ができず、従って、直ちに NO_x の調整に働かず、さらに空気供給導管中に水が溜ったりすると中のダンパの錆の原因となり作動不良をおこすなど、種々のクレームの原因となっていた。また、以上の従来例で、蒸気を吹き込む場合には、その蒸気の供給源が必要となり、これをボイラ等に求めると熱損失とな

り省エネルギーに反することにもなる。

【0006】本発明は、従来の技術の有するこのような問題点を鑑みてなされたものであり、その目的とするところは、燃焼装置からの排ガスを再循環させる再循環ガスを利用して、噴射水が燃焼用空気中に均一に混合されて燃焼ガス中の所望の低 NO_x 化が図れるような水噴射方法およびその装置を提供しようとするものである。

【0007】

【課題を解決するための手段】上記目的を達成するために、本発明における低 NO_x 燃焼装置における水噴射方法は、燃焼装置へ排ガスを再循環する循環系統に水噴射部を設けて再循環排ガス中に水を噴射させ、該水噴射部の後流側の燃焼用空気供給系との合流部に混合部を形成して、該混合部で噴射水を含む再循環排ガスと燃焼用空気とを強制的に均一に混合することを特徴とするものである。

【0008】また、請求項2においては、前記混合部の後流側に温度と湿度の検出部を設けて水の結露を抑制したことを特徴とするものであり、請求項3においては、前記水噴射部の後流側に温度と湿度の検出部を設けて水の結露を抑制したことを特徴とするものであり、請求項4においては、前記排ガスを再循環する循環系統に排ガス再循環ファンを設けて排ガスの再循環量および圧力を調整した後で水噴射部で水を噴射させ、その後流側の燃焼用空気供給系との合流部に混合部を形成して、該混合部で噴射水を含む再循環排ガスと燃焼用空気とを強制的に均一に混合することを特徴とするものである。

【0009】また、請求項5においては、請求項4に記載の手段で前記混合部の後流側に温度と湿度の検出部を設けて水の結露を抑制したことを特徴とするものであり、請求項6においては、請求項4に記載の手段で前記水噴射部の後流側に温度と湿度の検出部を設けて水の結露を抑制したことを特徴とするものである。

【0010】さらに、本発明における低 NO_x 燃焼装置における水噴射装置は、燃焼装置の排ガスダクトから排ガス再循環ダクトを分岐し、該排ガス再循環ダクトに水噴射器を配置して再循環排ガス中に水を噴射させることを特徴とするものである。

【0011】また、請求項8においては、前記排ガス再循環ダクトに排ガス再循環ファンを配置し、該排ガス再循環ファンの後流側に前記水噴射器を設けたことを特徴とするものであり、請求項10においては、前記水噴射器の後流側の排ガス再循環ダクトに燃焼用空気供給管を合流させ、該合流部に混合器を配置して、該混合器で噴射水を含む再循環排ガスと燃焼用空気とを強制的に均一に混合することを特徴とする。

【0012】また、請求項9においては、請求項8に記載の手段で前記水噴射器の後流側の排ガス再循環ダクトに温度と湿度のセンサーを配置して水の結露を抑制したことを特徴とするものであり、請求項11においては、

請求項10に記載の手段で前記混合器の後流側に温度と湿度のセンサーを配置して水の結露を抑制したことを特徴とするものである。

【0013】

【作用】上記のように構成された本発明における低 NO_x 燃焼装置における水噴射方法およびその装置では、燃焼装置へ排ガスを再循環する循環系統の再循環ガスの温度は通常150度C以上の高温であるので、該ガスに水を噴射した場合に、該水は全て蒸気となり燃焼用空気と均一に混合されて燃焼に供されて NO_x の発生を抑制することから、あえて蒸気を吹き込む必要がない。そして、前記循環系統内にセンサーを配置した場合には、該センサーによりガスの温度と湿度が制御されて再循環ガスの温度あるいは燃焼用空気の温度が低い場合に対応させて循環系統内での水の結露が抑制される。また、排ガス再循環ファンを配置した場合には、該排ガス再循環ファンにより排ガスの再循環量および圧力が調整されて燃焼装置の変動する負荷に対応させられる。

【0014】

【実施例】本発明の実施例を図1および図2を参照して説明する。図1は本発明に係る低 NO_x 燃焼装置における水噴射方法およびその装置をボイラに適用した一例を示すものであり、図2は他の例を示すものである。そして、いずれの場合でも、1はボイラであり、該ボイラ1は燃料供給導管2からの燃料と空気供給導管3からの空気がバーナ4に供給されて燃焼室5内で燃焼され、その燃焼による加熱によってボイラ1は蒸気を発生させている。そして、前記燃焼室5内で燃焼した燃焼ガスは排ガスダクト6から煙突7を経て大気へ放出される。

【0015】前記煙突7から放出される排ガス中に NO_x をなるべく含ませないため、前記排ガスダクト6には排ガス再循環ダクト8が分岐され、該排ガス再循環ダクト8の他端はバーナ4に接続されている。そして、該排ガス再循環ダクト8には水噴射器9が配置されており、該水噴射器9の後流側で前記燃焼用空気供給導管3との合流部には混合器10が配置されている。

【0016】以上のような構成によって、排ガス再循環ダクト8内の高温の再循環排ガス中に水噴射器9から所定量の水が噴射されると、該水は高温の排ガスによって全てが蒸気となり、該蒸気は水噴射器9の後流側で燃焼用空気供給導管3との合流部で混合器10によって排ガスと燃焼用空気の混合気に均一に混合されてバーナ4に送られ、該バーナ4において燃料供給導管2からの燃料と合わされて燃焼室5内で燃焼される。この燃焼の際、燃焼用空気中には NO_x の発生を抑制するための所定量の蒸気が均一に混入されているので、該蒸気により燃焼火炎温度が適当に下げられ且つ窒素や酸素の濃度も相対的に下げられることから、 NO_x の発生は十分に抑制できる。なお、燃焼装置の負荷の変動に対応して前記水の噴射量を調整すれば、該水の全てが NO_x の発生の抑制

に利用されることになることから、その調整が正確で容易にできるものである。

【0017】そして、前記水噴射器 9 の後流側や混合器 10 の後流側にガスの温度と湿度を検知するセンサー 11、12 等を配置した場合には、該センサーによりガスの温度と湿度が常時監視されて燃焼用空気量に対応して水の噴射量および／または再循環排ガス量が制御されて排ガス再循環ダクト 8 内に前記噴射された水や排ガス中の水分が結露することがない。従って、低負荷時の排ガスの温度が比較的に低い場合には水噴射器 9 の後流側のセンサー 11 により、また、冬期等の燃焼用空気の温度が比較的に低い場合には混合器 10 の後流側のセンサー 12 によって、前記結露が抑制されるのである。

【0018】なお、本発明の目的とする低 NO_x、すなわち燃焼によって発生する NO_x を抑制する程度によって噴射すべき水量や再循環すべき排ガス量が決められるが、それらの量を燃焼用空気に混合して燃焼室内へ運び込むことが必要となる。その場合、もしその排ガス再循環の量と圧力が足りなければ目的の水を噴射して入れることができなくなる。そのために排ガス再循環ファンが必要になることがある。

【0019】そして、その取付位置は、該排ガス再循環の量や圧力がそれほど大きくないときは図 1 の排ガス再循環ダクト 8 に取り付け（図示さす）ても良いが、そのときにそれらの量や圧力が大きくなると燃焼用空気押し込みファン 14 において、特に起動時の冷態時の排ガス再循環のガス温度が低いときなどには、その風量などを特別に制御したりしなければ必要動力が上がって運転できないことがある。

【0020】そこで、図 2 に示すように排ガスを再循環する排ガス再循環ダクト 8 内に排ガス再循環ファン 13 を設けて、排ガスの再循環量および圧力を調整した後で前記水噴射器 9 で水を噴射させるようにすると、上記の不都合はなくなる。

【0021】そして、前記センサー 11、12 等の配設および排ガス再循環ファン 13 の配設は必要に応じて取捨選択して各種組み合わせることができるものである。

【0022】

【発明の効果】本発明によると、燃焼装置へ排ガスを再循環する循環系統に水噴射部を設けて再循環排ガス中に水を噴射させるようにしたので、低 NO_x 化用の蒸気を供給源とすることなく、水は蒸気化されて燃焼用空気供給系に強制的に均一に供給されることから、吹き込んだ

水が途中のダクトに溜り、あるいは炉内で不完全燃焼や熱交換器等の損傷をおこさせることなどの不都合がなく、しかも、リアルタイムに NO_x の発生を抑制することができるのである。また、燃焼装置の負荷の変動に対応して前記水の噴射量を調整すれば、該水の全てが NO_x の発生抑制に利用されることになることから、その調整が正確で容易にできるものである。

【0023】また、水噴射部の後流側や混合部の後流側にガスの温度と湿度を検知するセンサーを配置した場合には、該センサーによりガスの温度と湿度が常時監視されて燃焼用空気量に対応して水の噴射量および／または再循環排ガス量が制御されて排ガス再循環ダクト内に前記噴射された水や排ガス中の水分がダクト内で結露することがないことから、特に、低負荷時の排ガスの温度が比較的に低い場合や冬期等の燃焼用空気の温度が比較的に低い場合にも水の有効な利用が可能となると共に、機器の損傷も予防できて更に正確容易な NO_x の発生抑制ができる。

【0024】また、排ガスを再循環する循環系統に排ガス再循環ファンを設けて排ガスの再循環量および圧力を調整した後で水噴射部で水を噴射させてその後に燃焼用空気に混合する場合には、起動時の冷態時等で排ガスの温度が低く、あるいは該排ガス量が大きい場合でも、押し込みファンの容量が足りなくなったり、過電流でトリップしたりしないように、予め該ファンの容量を大きくしておかねばならない、という問題もなくなる。

【図面の簡単な説明】

【図 1】図 1 はこの発明に係る低 NO_x 燃焼装置における水噴射方法およびその装置を実施するに適した一実施例の流れ図である。

【図 2】図 2 は他の実施例の流れ図である。

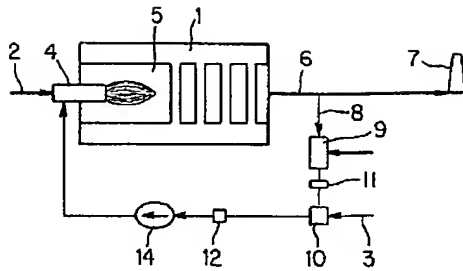
【図 3】図 3 は従来例の流れ図である。

【図 4】図 4 は他の従来例の流れ図である。

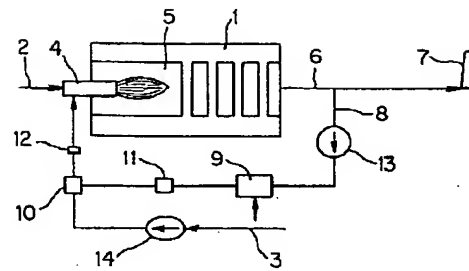
【符号の説明】

1	ボイラ
3	空気供給導管
5	燃焼室
6	排ガスダクト
8	排ガス再循環ダクト
9	水噴射器
10	混合器
11, 12	センサー
13	排ガス再循環ファン

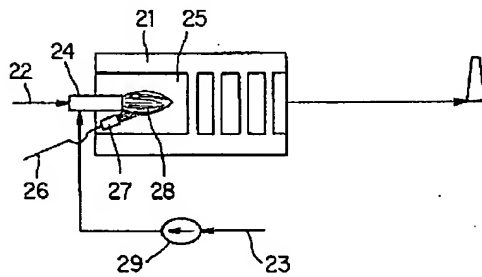
【図 1】



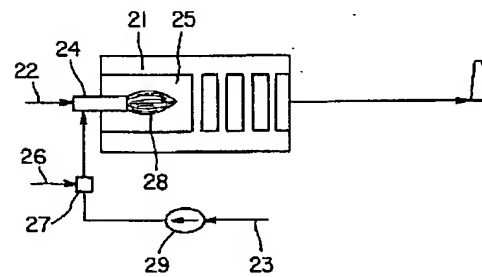
【図 2】



【図 3】



【図 4】



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